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PRINCIPAL PAPER

PRESENT STATUS OF THE AHINAHINA OR SILVERSWORD *Argyroxiphium sandwicense* DC. ON HALEAKALA, MAUI

By Herbert K. Kobayashi[1/]

The February issue of the HBS Newsletter featured a 25-year-old article on the Ahinahina (Bryan 1948) and recent comments by the author and editor on the Big Island plants. I have just completed a 4-year study on Haleakala's plants for the Hawaii Natural History Association (Kobayashi 1973) which may interest Newsletter readers because it completes the story on the present status of this well-known endemic species found only on Maui and the Big Island.

Distribution and Abundance on Haleakala

Unlike the Big Island plants which number only about a hundred and require protection from herbivores (footnote Feb. Newsletter), Haleakala plants number well over 40,000 and are found mostly on the nearly barren western crater floor (see table on page 24) away from shrubby areas frequented by goats (Yocum 1967). Numbers in the table are actual counts of plants from a distance of less than 100 meters using 6X binoculars; therefore small plants in large populations are probably underestimated, but plants greater than about 20 cm diameter are accurately tallied because of their smaller number,

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SHOUT
SHARE
IT

Number of Silverswords at Various Locations on Haleakala Crater, Maui 1969-72

Nearly barren cinder cones:	
Puu-o-Maui	22,000
Ka-Moa-o-Pele	3,900
Puu-o-Pele	3,400
Puu Naue	3,400
Puu Nole	3,000
Kamoalii	1,500
Halalii	44
Puu Kauaua	7
Ka-Lua-o-Ka-One	0
Vegetated cinder cones:	
Puu Maile	8
Kahuina-ka-One	7
Namana-o-ke-Akua	0
Aa flows (almost no pahoehoe in Park):	
Red flow from Puu-o-Maui including Silversword Loop	1,900
Between Puu Maile & Puu Nole	36
Crater rim and outer crater slopes:	
North rim	0
South rim	35
East rim	0
West rim	180

larger size, and more conspicuous appearance. The location, areal size, and counts in three classes of all populations of more than 25 plants can be found in Kobayashi 1973.

This 3-year survey showed that 99% of the plants were in a 10 sq-km triangle whose base line extended from Magnetic Peak to Puu Maile, the Silversword Loop being the northern apex. Fully 50% of the silverswords were on centrally located and most isolated cinder cone, Puu-o-Maui. Kalahaku Overlook on the heavily visited western rim (157 plants) was the only cluster of more than 25 plants outside of this triangle which lies wholly within the crater.

The western crater floor has had the highest number of plants for many decades (Alexander 1870, Lamb 1935a, St. John in Anonymous 1945, Badaracco 1962) although Degener (1930) found barely 100 within the crater in 1927. Only 8 years later, Lamb (1936) reported "thousands of plants in the crater," and counted 1470 on Ka-Moa-o-Pele cinder cone alone (Lamb 1935b). Recounts on Ka-Moa-o-Pele by Badaracco (1962, 1248 plants) and myself (1971, 3990 plants) show that this cone chosen by Lamb for its typical conditions has sustained a high rate of regeneration for the past 40 years. A craterwide estimate of "perhaps 10,000" was made 10 years ago by Badaracco (1963). Apparently, Haleakala's silverswords are thriving and even increasing under the aegis of the National Park Service.

The fate of the silversword is usually linked to insect larval damage to seeds, removal of plants by visitors, and browsing by goats. My research shows that at the present and in the near future these factors may be secondary to root breakage and root exposure caused by trampling around young plants. With the increase in visitors each year, trampling may become the greatest factor detrimental to the preservation of the Haleakala silversword.

Insect Larval Damage to Seeds

Since the time of Hillebrand (1854) insects have been blamed for the decrease in silverswords despite the opposite conclusion of the only field study made on this problem (Lamb 1936). At least three arguments can be raised in support of Lamb -- details, references, and supporting data will be forthcoming in a paper submitted for publication in the 1973 Proceedings of the Hawaiian Entomological Society.

1. Larval damage to seeds, unlike vandalism and browsing, is a natural ecological factor present long before the coming of man. The most destructive insects (tephritid fly and phycitid moth) are specific to the Argyroxiphium sandwicense and its close relatives; therefore, their existence depends on the survival of sufficient seeds to avert extinction of their hosts. The situation is similar to the Yucca-moth relationship familiar to botanists.

2. No floral head was found with 100% destruction of seeds during the examination of hundreds of heads in every flowering population of 1969 and 1971. Field sampling during 1971 revealed that at least 3% of the viable seeds were available for dispersal in the most heavily infested population. Although the average viability decreases sharply, silversword seeds are able to germinate after being stored for at least 4 years according to my annual laboratory germination of the 1968 crop.

3. Large dense populations are more heavily infested as compared to small isolated populations according to a field sample of 12 selected populations. Since the large populations have remained in a high state of regeneration for several decades, this implies that high infestation may not necessarily lead to a drop in number. Also, the small isolated populations being lightly infested may act as nuclei for the reseeding and eventual reestablishment of the crater floor populations.

Removal of Plants by Visitors

Prior to the establishment of a permanent ranger station in 1929, whole plants were uprooted and brought down as proof of a visit to the summit. On the front page of the Honolulu Advertiser Feb. 23, 1911, a photograph shows Maui's entry in the Washington's Birthday Annual Floral Parade: a touring car completely decorated with large silverswords, even to plants fastened to wheel spokes! Even today, with only one exit by car from the Park, vandalism goes on constantly, sometimes the guilty ones are apprehended (Advertiser March 28, 1961, Star-Bulletin August 24, 1971). Vandalism at the Kalahaku Overlook is discussed briefly later under "root breakage and exposure."

Effect of Browsing by Goats

Bryan (1948) reported seeing hundreds of Haleakala plants browsed by goats during the early 1920s. But 10 years later the impact of browsing had lessened to where only one or two incidents were seen by qualified informants (Lamb 1935a). Controlled hunting has reduced the goats from over 4,000 twenty years ago to the present number of about 600 which are found mostly along the crater rim (Yocum 1967, Larson 1969).

In addition to reduction of goats by hunting, there are other reasons why browsing is probably not reducing the present range and abundance of Haleakala's silverswords.

First, the silversword is probably not eaten in preference to other plants according to my 3 years of field observation during all seasons. Several times goats were seen eating Pukiawe (consumed as a last resort according to Yocum 1967) within 200 meters of mature silverswords. Goats have not visited the high density populations on Puu Nole easily seen and accessible from Namana-o-Ke-Akua cinder cone only 600 meters away, one of the most heavily browsed areas in the Park. Also the easily identifiable leaves of the silversword were not among the 9 plant species found in the stomach contents of 33 goats shot in January 1947 (Yocum 1967).

Secondly, browsing in recent time is usually infrequent, occurs on the periphery of the silversword "triangle," and does not necessarily kill a plant because lateral branches may develop with the removal of the single apical bud. Lamb (1935a) interviewed qualified laymen and scientists who reported no browsing or only isolated instances of browsing. During the past 5 years, the only plants reported eaten were 13 large ones in a quarter-hectare area on the western rim near the Kalahaku Overlook, a locale very low in forage and high in goat density (see map in Kobayashi 1973 for exact location of plants). Although showing remarkable recuperative powers, repeated browsing has killed the majority of the plants (personal communication, L. Guth, Park Ranger, Haleakala N. P. 1972). However, several small plants nearby under my observation have survived by activation of several lateral buds (see photo in Kobayashi 1973). Excavation of dead flowered plants abutting each other by Lamb (1936) and myself revealed that A. sandwicense is frequently multibranched as in all other species of Argyroxiphium. Moreover a branch may have several flowering racemes (photo in Anonymous 1943). On a plant I photographed in 1969, these may even occur on a branch which flowered in the usual manner during a previous season. Since I have found that small plants are not branched, and branched plants are in areas frequented by goats (notably the western crater rim and the Silversword Loop), the possibility that "tillering" may actually increase the longevity and the seedcrop of a browsed plant cannot be overlooked.

On Haleakala, there is evidence that A. sandwicense is killed by root breakage caused by trampling. Broken roots were found on dozens of dead or dying plants along the road and trails. These were mostly plants of less than 10 cm crown diameter with roots partially exposed; other causes of death were not apparent.

Long-term data also tend to confirm the impact of trampling in the Kalahaku Overlook population, the most visited cluster of silverswords in the Park. Thirty-two plants tagged in 1968-69 and 27 plants photographed in 1964 were measured in 1972. Half of the plants were missing or growing at a rate of less than one inch diameter per year, and these were mostly the smaller plants. Theft may also be involved because plants apparently large enough to withstand trampling in 1964 are now completely missing.

Apparently, Haleakala's silverswords are rooted in a medium (sand-textured cinder) easily disturbed by large animals, particularly the western crater rim (Yocum 1967). Root hairs penetrate deeply into the highly porous material and root tips become firmly attached to cinder fragments. Consequently, any movement of the normally loose, non-cohesive medium easily separates the water-absorbing portions of the root system from the rest of the plant. Younger plants are more vulnerable since their roots are still structurally weak, and their root hairs are fewer in number and located closer to the ground surface.

Summary

Argyroxiphium sandwicense DC. is presently not endangered on Haleakala. Fully half of the 43,000 counted on the crater are on Puu-o-Maui cinder cone, the most isolated and least disturbed area where optimum regeneration conditions are found (see Chapter II of Kobayashi 1973 for conditions). If large animals including man are kept away from the high regeneration areas, the silversword should be able to maintain itself indefinitely within the crater.

Under the management of the National Park Service, vandalism and browsing have not appreciably changed the distribution and abundance of Haleakala's silverswords during the past few decades. But with increase in visitors, root breakage and exposure by trampling, now occurring mostly along and near the western crater rim, may become a factor among the high-regeneration populations within the crater.

The impact of seed damage by insects is probably of secondary importance. Its role in an environment increasingly disturbed by man is unresolved and awaits further investigation.

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1. a literature review on the Hawaiian silverswords and plants of similar life form in other alpine areas of the world.
2. a dissertation defining and experimentally verifying a hypothesis on ecological factors governing the regeneration of the silversword on Haleakala Crater.
3. specific recommendations on the maintenance, propagation, and restoration of the silversword on Haleakala Crater.

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EVENTS

Wau Ecology Institute (Letter from Dr. Gressitt)

The Wau Ecology Institute is still in need of outside financial contributions, before it can stand adequately on its own feet. I wonder if the Botanical Society could make another contribution?

We have been making great progress in expanding our arboretum several-fold on new land recently acquired. However, we may not be able to retain the added staff engaged for this purpose without additional financial help.

I hope that more members of the Society may have the opportunity of visiting here to see what we are doing, or to participate in our development.

Sincerely,

J. L. Gressitt, Director

Phytophthera cinnamomi

Dr. Frank Newhook, Professor of Plant Pathology, Auckland led a seminar at the University of Hawaii on August 24, on the topic of forest decline in Australia and the role of the root disease fungus Phytophthera cinnamomi. The topic is of special interest to us in Hawaii because of the similarity to the epidemic decline of the ohia rain forest on the Big Island. Dr. Newhook inspected the decline areas on the Big Island in company with local scientists on August 27th and 28th. He stated that he believes that P. cinnamomi, or similar root disease, must be the major factor in the epidemic decline. Dr. Ivan Buddenhagen, University of Hawaii Department of Plant Pathology arranged for this timely visit by Dr. Newhook.

R. Nelson

American Deer were First

American, not Axis, deer were first introduced in Hawaii nei.

Captain Alexander Adams (12/27/1780 - 10/27/1871) was harbor pilot in Honolulu when James Macrae, botanist on Lord Byron's vessel, the "Blonde," came to the Hawaiian Islands. According to Macrae's entry in his diary for May 29, 1825: "Mr. Adams amused us throughout the day relating curious anecdotes of the late Tamaha maah [Kamehameha] and his queens, particularly about Kaumanna [Kaahumanu]. Adams had been on the islands since 1809, sometimes conveying sanders wood [sandalwood] to China, at other time to the North-West coasts of America with cargoes of salt. He brought home a couple of deer the last time with a view of their thriving in the islands, but they had not long been suffered to go at large in Hanaruru [Nuuanu] Valley, when Pitt [Billy Pitt or Kalanimoku, elder brother of Boki and Governor of Oahu] happening to be unwell, fancied that the flesh of the deer would do him good, and one of them was killed for him to taste. This he found so much to his liking that he ordered the other one to be killed, thus ending the life of poor Adams' deer."

The catastrophic introduction of axis deer from the Orient came much later. To prevent these "four-legged locusts" from being scattered from island to island to exterminate the endemic biota and to destroy our watersheds will take continuous education of the general public and vigilance.

Otto and Isa Degener

Moanalua Valley

National Historic Landmark status for Moanalua Valley has been denied. Detailed research has apparently not been able to substantiate the alleged historical significance of the valley areas. A report titled "Analysis of Moanalua Historic Landmark Application Significance Statement," September 1973, State of Hawaii, is well worth reading. The highly qualified authors of this report seem to have well substantiated their conclusions as expressed by these statements: P59--"In general I find the (Holts') Significance Statement to be inaccurately, poorly footnoted, and overstated." P65--"The Significance Statement contains factual inaccuracies, sloppy citations, questionable interpretations, faulty logic, misleading subtleties of wording, inflated claims, and amazing feats of linking legends and history specifically to Moanalua."

(Ed.)

Ahihi Bay - Cape Kinau Natural Area Reserve

The first area designated as a Natural Area Reserve under the provisions of Act 139 is the Ahihi Bay - Cape Kinau area on Maui. Much credit is due to Dr. John Maciolek for getting Reserve status for the area.

Further information about this Natural Area Reserve may be obtained from Mr. Steve Montgomery, Department of Land and Natural Resources

Hawaii State Constitution

Art VIII Public Health and Welfare

Section 5. Public Sightliness and Good Order

> The State shall have power to conserve and develop its natural beauty, objects and places of historic and cultural interest, sightliness and physical good order, and for that purpose private property shall be subject to reasonable regulation.

Art X Conservation and Development of Resource

Section 1. Resources; Conservation, Development and Use

> The legislature shall promote the conservation, development and utilization of agricultural resources, and fish, mineral, forest, water, land, game and other natural resources.

Section 5. Farm and Home Ownership

> The public lands shall be used for the development of farm and home ownership on as widespread a basis as possible, in accordance with procedures and limitations prescribed by law.

Hawaii Environmental Policy Act

The Temporary Commission for Statewide Environmental Planning issued its first full report in August 1973. It has held hearings throughout the State during September, receiving considerable and varied reaction. The topic is much too complex to cover in the Newsletter. Every Society member should read the full report of the Commission and follow its future actions.

(Ed.)

SOCIETY BUSINESS

Minutes of the Regular Meeting - June 4, 1973 (slightly edited)

The meeting was brought to order by the president, Ted Green at 7:35 PM. The treasurer's report submitted for June showed balances of $11,402.41 in the Neal Fund; $517.03 in checking; $117.59 in savings. There were 54 members and 8 guests in attendance.

Among the correspondence received were agricultural regulations, the Plan for Department of Defense Facilities, and an announcement pertaining to the Wau Ecology Institute, Papua-New Guinea.

Ruth Gay (Conservation Committee) said that the Society received letters of thanks from the Honolulu City Council and the Outdoor Circle for our efforts in planning the Ala Moana Drainage Canal. She circulated a draft summary of environmental recommendations from various sources to the Governor's Temporary Commission on Environmental Planning, to which the Society provided input last year. Representatives from the Society, and others met jointly with the Office of Environmental Quality Control and a Federal forestry inspection team to review conservation issues pertaining to forestry in Hawaii. She announced a planned symposium on "Natural Areas, Ecological Reserves and Wilderness Areas in Hawaii, the U. S. and the Pacific Basin."

Reporting for the Agricultural Advisory Committee, Ron Hurov said that Legislative bills had been signed granting small farmers land leases up to 35 years so that they could obtain monetary loans. He attended a meeting of the indoor decorative industry. He announced a meeting of the Society of Economic Botany to be held at Cornell University. A discussion followed regarding an environmental impact statement regarding the construction of a new art building on the UH campus with the consequent destruction of Gilmore Hall.

In OLD BUSINESS, it was suggested by Mae Mull that the Society's statement prepared for the Governor's Temporary Commission on Environmental Planning be printed in the Newsletter. The Secretary summarized the status of the proposed list of plants in the Honolulu Botanic Gardens for which the Society had been approached for funding. The request for funding was denied.

In NEW BUSINESS, an amendment to the bylaws was suggested by Milton Manhoff. He moved that a life membership be created, the qualifications to be decided by the Executive Board, with the concurrence of the membership, for longtime members of the Society. The motion for this fourth type of membership passed.

Dr. Warner showed some fruit of new varieties of soursop, pineapples, mangoes and bananas from the Waimanalo Experimental Station.

The program chairman, Dr. Theobald, announced a summer foray tentatively to Kahana Valley on July 1. He then introduced the speaker, Mr. Norman K. Carlson, Bishop Estate Land Manager, Kona Branch who spoke on "Problems and Prospects for the Privately-owned and Exotic Forests."

The meeting adjourned at 9:15 PM.

W. C. Gagne

Hawaiian Botanical Society Constitution (Excerpts)

Article II. The objectives of this Society shall be:

a. to advance the science of Botany in all its applications.
b. to encourage research in Botany in all its phases.
c. to promote the botanical welfare of its members and to develop the spirit of good fellowship and cooperation among them in botanical matters.

Article VI. Section 1

a. The Hawaiian Botanical Society shall be organized exclusively for scientific and educational purposes.
d. No substantial part of the activities of the Hawaiian Botanical Society shall consist of carrying on propaganda, or otherwise attempting to influence legislation.
e. The Hawaiian Botanical Society shall not participate in, or intervene in (including the publishing or distribution of statements) the political campaign on behalf of any candidate for public office.

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THE HAWAIIAN BOTANICAL SOCIETY NEWSLETTER is published in February, April, June, October, and December. It is distributed to all Society members for the purpose of informing them about botanical news and progress in Hawaii and the Pacific. News contributions and articles are welcomed.

THE HAWAIIAN BOTANICAL SOCIETY was founded in 1924 to "advance the science of Botany in all its applications, encourage research in Botany in all its phases," and "promote the welfare of its members and to develop the spirit of good fellowship and cooperation among them." Any person interested in the plant life of the Hawaiian Islands is eligible for membership in this Society.

Dues: Regular, $5.00 per year
Family, $7.50
College students, $2.00
Students below college level, $1.00

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